outer surface of the coral is minutely granular. The polypes are completely retractile; the base of their tubes is strengthened with very minute spicula, placed in a longitudinal series parallel to each other.

1. Bellonella granulata. (Woodcut, p. 36.)

Hab. Bellona Reefs, 17 fathoms (*T. M. Rayner, Esq.*).

6. Contribution to the Knowledge of the British Charrs. By Dr. Albert Günther.

(Plates V., VI., VII.)

The production of the following paper has been induced by two specimens of the so-called Freshwater Herring of Lough Melvin in Ireland, which were procured by Joshua Walker, Esq., and submitted to my examination. The differences from the allied Continental species were so striking, that from the first moment I could scarcely doubt that I had a species before me which I had never seen before. In the first place it appeared necessary to compare it with specimens from other localities of Great Britain—with the true British Charr; but, although the period of the year (November and December) appeared to be the most favourable for the capture of those fishes, as they approach the shores to spawn, afterwards returning to the deepest parts of the lakes, I have been only partly successful in obtaining more specimens, and I particularly regret not having been able to examine specimens from Scotland, either in a fresh state or preserved in spirits*. I have obtained, however, materials sufficient for the determination of the Charrs of three localities, by the kind assistance of the gentlemen who will be mentioned hereafter. Our knowledge of the representatives of the Charr on the Continent is chiefly due to Heckel, Nilsson, and Rapp, in whose descriptions due attention has been paid to those characters by which the species may be distinguished; and for a comparison of the British Charrs with those of the Continent I have had to rely chiefly on them. My materials were the following:—

a. *Freshwater Herring of Lough Melvin.*

Two fresh specimens, mature males; by the kindness of J. Walker, Esq.

One specimen (dried skin) in the British Museum.

b. *Welsh Charr, or Torgoch.*

Nearly twenty specimens from Llanberris, all mature males; received by the kindness of S. P. W. Ellis, Esq., Chief Constable of Carnarvonshire, and G. Ellis, Esq.

Four young specimens from the lake Coss-y-gedawl, transferred

* Dried and stuffed specimens of Charr are of little or no use.

with Mr. Yarrell's collection to the British Museum (*S. salvelinus*, Jenyns).

c. *Charr of the Lake of Windermere.*

Two mature males, procured by the kindness of Sir J. Richardson.

For further comparison I had the "Röthel" of the Lake of Constance, the "Ombre chevalier" of the Lake of Geneva, four specimens of a Charr from Iceland, and twelve without known locality.

Before we enter into a historical account of our knowledge of the British Charrs, we must consider the question, what fishes have been originally intended by the Linnean denominations of *Salmo umbla*, *Salmo salvelinus*, and *Salmo alpinus*—names with which the British Charrs have been designated by the various authors.

The original descriptions themselves are too short and too general to give anything like specific distinctions; but fortunately we see that question settled, once and for ever, by the very names of the fishes and by the localities from which the typical specimens had been procured. J. Heckel has made inquiries into this subject with regard to the *Salmo salvelinus* of South Germany*, and the following is the result:—

a. *Salmo salvelinus*, L. Linnæus has founded this species on the tenth species of *Salmo* in Artedi's 'Genera,' or on the eleventh in his 'Synonymy'; and Artedi had derived the whole of his knowledge of this fish from Willoughby, who (p. 195) gives a description of the "Salvelin" from a specimen captured near the Austrian town of Linz. Therefore there cannot be the slightest doubt that the Linnean denomination is intended for the South-German fish, which, up to the present day, is called *Sälbling* at various localities.

The best account of the Sälbling has been given by Heckel, who says that they are found in several lakes of South Germany, Tyrol, and Switzerland. First (*l. c.*) he distinguished three species according to the different arrangement of the small teeth on the vomer; afterwards†, having convinced himself that this character is subject to some variation, he reunited those three forms, stating at the same time that those fishes from different localities of Central Europe considerably differ in their *forms*. And it is not at all improbable that there are really several species confounded by him, but differing and distinguishable by other, more constant, characters than by that of the arrangement of the vomerine teeth. Be this as it may, it suffices for our purpose that Heckel distinguishes those fishes of Central Europe by the considerable breadth of the interorbital space, which is twice the diameter of the eye. Also the figure‡ (which is rather indifferent) represents a remarkably small eye; the pectoral fin occupies only one-half of the distance of its root from that of the ventrals; and when we compare the British specimens, we find that their head is much narrower, their eye much larger, and their pectoral

* Reisebericht, p. 89, in Sitzungsber. Akad. Wiss. Wien, 1851, July.
† Süsswasserf. Oestr. p. 280.
‡ Süsswasserf. fig. 155.

fins much longer than in the fishes described by Heckel, and consequently that none of them can be identical with the South-German Sälbling or with the *Salmo salvelinus* of Linnæus.

b. *Salmo umbla*, L. Linnæus has founded this species on the ninth species of *Salmo* in Artedi's 'Genera,' or on the seventh in his 'Synonymy,' the latter ichthyologist following Rondelet, who described the "Salmo Lemani lacus, seu Umbla*," or the "Ombre (chevalier)" of the Lakes of Geneva and Neuchatel. Jurine† and Agassiz‡ have given figures of this fish. Far superior to them is that published by Rapp§, who has identified the "Röthel" of the Lake of Constance with the *Salmo umbla*, L.

This species never assumes the red colours of the *S. salvelinus*, or of the Charrs of Windermere and of Wales. It could be compared in this respect only with the "Freshwater Herring" of Lough Melvin, from which it is readily distinguished by its much larger teeth, by its wide mouth, the maxillary extending to behind the orbit, by its much more elongate body, and by the proportions of its fins. *Salmo umbla* of Linné differs from the British Charrs (as far as we treat of them in this paper) in nearly every one of the external characters, and agrees with the Irish species only in its plainer coloration and in the size of its scales.

c. *Salmo alpinus*, L. Linnæus, on his tour through Lapland, discovered in the mountain-lakes of that country a species of Charr, which he described in the 'Fauna Suecica,' p. 117, no. 310, and which he named *S. alpinus* in the 'Systema Naturæ.' He adopts the opinion of Artedi in referring the British Charr (which he knew from Willoughby's description) as a synonym to this *S. alpinus*. Even the few details which are given in his and Nilsson's descriptions do not admit of an identification of those species. Linné says that the length of the head of the typical specimen was $1\frac{1}{2}$ inch, and the distance from (the front margin of) the dorsal to the adipous fin 3 inches: in the British Charrs the head is much longer. He found the length of the head equal to that of the base of the dorsal fin: in British Charrs the base of that fin is much shorter. Nilsson describes the *S. alpinus*, L., as a distinct variety of *S. salvelinus*, distinguished by short fins; but *S. salvelinus*, Nilss., has shorter fins than any of the British Charrs.

We are, therefore, not justified in admitting one of those Linnean denominations for the British species which will be described in this paper. This view being in contradiction with that of all former writers, I think it necessary to give a *historical review* of what has been done on the subject. Not a love of starting novel views, much less an ill feeling towards any of the previous inquirers, but the plain necessity of supporting the truth of my opinion forces me to show where observations have been imperfect, or where they do not agree with nature. Conscious of the imperfectness of my own labour, I

* Rondel. ii. p. 160.
† Poiss. du lac Léman, pl. 5.
‡ Poiss. d'eau douce, pls. 10 & 11 (but not pl. 9).
§ Bodensee-Fische, p. 32. taf. 5.

should not be wise to provoke just retribution by unfair severity towards others.

1685. Willoughby is the first who with the practised eye of an ichthyologist examined the Charrs of England and Wales, devoting a separate article to their description*. He recognizes their affinity to the Sälbling (*S. salvelinus*), and lets the descriptions of the German and British fishes follow one another; but the "Torgoch" of Wales and the "Red Charre of Winander-mere" appear to him to be the same species, with which he unites even the "*Reutele*" or Röthel of South Germany—a fish which, however, appears to have been known to him rather by name or by recollection than by actual examination and by comparison with the British fish.

At a time when naturalists were only beginning to advance beyond the individual specimen to the conception of classification, and to form the ideas of species and genera, it was creditable enough to note the British Charrs on the whole as different from the Sälbling, and, at the same time, to indicate their affinity.

Willoughby mentions the *Gilt Charr* beside the Red Charr, also from the lakes of Westmoreland, considering it identical with Salviani's Carpione from the Lago di Garda†. In the description of the latter he says (p. 197), "*In palato quinque dentium areolæ*," whilst he expressly and correctly mentions that the middle of the palate is toothless in the Sälbling as well as in the Red Charr. Therefore the Gilt Charr, as it is understood by Willoughby, cannot be a true Charr without teeth along the middle of the vomer (*Salmo, sensu stricto*); but it is a species of Salar or Fario, with five series of teeth along the roof of the mouth, viz. two along the maxillaries, two along the palatines, and one along the vomer.

We shall see that Pennant and Yarrell mention the Gilt Charr (of which I have not seen an example) as a variety of the common Charr; but what Pennant says about its habits and propagation tends to show that Willoughby was perfectly right in referring it to (or near to) a very different species.

1738. The confusion commences with Artedi and Linnæus, who, without knowing the British fish, refer Willoughby's Red Charre to the *Salmo alpinus* from Lapland.

1755. Farrington, in a letter printed in the 'Philosophical Transactions' of that year, gives some notes about the general appearance and the habits of the Torgoch. He very truly remarks that the fish is "slimy, nearly allied to the eel and the tench." From the specimens which I have examined I cannot confirm his observation that "the male is not adorned with the beautiful red hue of the female;" "yet," he continues, "he is finely shaded and marbled upon the back and sides with black streaks." "The Turgoch makes its appearance at the shores of the Llanberris lakes about the winter solstice; the whole number annually taken in the two pools of Llanberris does not amount to a hundred dozen."

* Will. Hist. Pisc. p. 196.

† See Heckel, Reisebericht, p. 98 (*Salmo carpio*, L.; *Fario carpio*, Heck.).

1776. Pennant knows that the Charr occurs not only in England and Wales, but also in Scotland, whilst he had not received any evidence of its existence in Ireland. He first mentions the fact, which is repeated in all other works, that the Charrs of the Lake of Llanberris were entirely destroyed by noxious waters flowing from copper-mines in the neighbourhood*. He has examined the *Red or Case-Charr* and the *Gilt Charr*, but considers both as the same species, although the former spawns about Michaelmas, ascending the River Brathay, whilst the spawning-season of the latter extends from the month of January to that of March, the fishes remaining in the sandy parts of the lake. If this Gilt Charr (Pennant's) is identical with that of Willoughby, and if the observations of both these naturalists really refer to the Gilt Charr of the present day, it is clear that it is not a variety of the common Charr, but a species widely different from it.

1802. The knowledge of those fishes is considerably advanced by Donovan, who well perceives the differences between the Torgoch and Charr, but is unable to fix the distinctive characters in specific terms, resorting for the purpose of diagnosis to the differences in colour, which in his figures are much exaggerated and untrue. In his description, he is quite right in directing particular attention to the slender form of the Torgoch, and he might have added another important character which is indicated in the figures, namely, that whilst in the Charr the root of the pectoral is quite free, and not overlapped by a prolonged suboperculum, the latter is produced backwards and downwards in the Torgoch. The physiognomy of the fishes has lost much by representing the eye too small; whilst the differences in the structure of the nostrils apparently have been noticed by him. He employs for the Charr the Linnean name of *S. alpinus* (pl. 61), and for the Torgoch that of *S. salvelinus* (pl. 112).

1807. Turton follows Donovan, and evidently has examined the Torgoch, as he gives the correct number of the dorsal rays, viz. thirteen. The statements of the different authors, especially of the earlier, with regard to the fin-rays, can be used only with great caution,—first, because they had only partly recognized the value of that character; and secondly, because they counted them in different ways, frequently omitting the small rays in front of the fins.

1812. The first definite notice of the occurrence of a Charr-like fish in Ireland appears to be due to Dubourdieu, who, in his 'History

* This fact is doubted by Mr. S. P. W. Ellis, who writes, in answer to my inquiry on this subject, "Llanberris Lake is three and a quarter or four miles long; the width varies, the greatest width being about three-fourths of a mile; the greatest depth is said to be 40 fathoms. The quantity of water coming from copper-works is not more than one-tenth part of the whole volume, and this portion flows about five miles before falling into the lake, and, besides, passes through a mountain lake after having left the mine. Below this mountain-pool the water is not poisonous to fish. The quantity of water from copper-mines has decreased in this valley, owing to the stoppage of works. I cannot think there ever were mines worked to any such extent as seriously to injure fishes. The chief works are slate-quarries." J. Petherick, Esq., who has a thorough knowledge of these mines, a part of which are worked by himself, also is of the same opinion.

of the County of Antrim' (vol. i. p. 119), in a list of the fishes of Lough Neagh, enumerates the *Whiting*, which by a friend of the author, Mr. Templeton, is declared to be the *S. alpinus*. A rough drawing is added. As the description does not give any specific characters, we are left in doubt about the correctness of the determination. It is probable that the Whiting of Lough Neagh is now extinct.

Thompson* says that, when visiting Lough Neagh in 1834, he was assured by the fishermen that they had not known of any of those Whitings being taken in that lake for at least ten years previously. This is confirmed by R. Patterson, Esq., of Belfast, in a letter addressed to me, in which he states that the Charr "has been believed to be extinct in that lake for more than thirty years." Therefore, the question whether the Whiting of Lough Neagh was identical with one of the other species, or whether it was a distinct species, will remain unsolved. Surely, if any group of fishes requires particular care in collecting and preserving its representatives at different localities, it is that of the Charrs, which, confined to very limited localities, and extremely susceptible to the changes of their element, are exposed to the danger of easy destruction: the Torgoch of Llanberris disappears for a series of years, (as it is said) in consequence of the poisonous fluids carried down from the copper-mines of the neighbourhood; the Charr of Lough Neagh becomes extinct, from reasons unknown. We are afraid there are other similar instances, but unrecorded in natural history.

1834. Agassiz, engaged in the examination of some of the continental *Salmonidæ*, and having compared them with those in Great Britain, declared, at the meeting of the British Association of that year, that the Charrs of England and Ireland, the Ombre chevalier of the Lake of Geneva, and all the different Charr-like fishes of Sweden, Switzerland, and all the southern parts of Germany were one and the same species—or that *S. umbla*, L., *S. salvelinus*, L., *S. alpinus*, L., and *S. salmarinus*, L., were merely synonymous†.

Heckel already has shown, with regard to the Swiss representatives of Agassiz's *S. umbla*‡, that two very different species are comprised in it, different in the size of the scales, in the shape of the body, in the coloration, and, according to Rapp's researches, in the number of the vertebræ—or that the *S. umbla*, figured by Agassiz, 'Poiss. d'eau douce,' pls. 10 & 11, is the true *S. umbla* of Linné, from the Lake of Neuchatel, but that the *S. umbla*, Agassiz, pl. 9, is identical with *S. salvelinus*, L., from the Lake of Zurich.

Nor can I arrive at the same conclusion as M. Agassiz with regard to the British Charrs known to me. It is much to be regretted that in that paper neither the localities are mentioned whence the specimens examined were obtained, nor that the opinion started was supported by a comparative description; and we cannot assume that M. Agassiz's opinion referred to Scotch specimens only (which

* Ann. & Mag. Nat. Hist. 1841, vi. p. 448.

† Report of the Fourth Meeting of the British Association, at Edinburgh, p. 622.

‡ Reisebericht, p. 91.

I had no opportunity of examining), as he speaks of the Charr of England and Ireland. M. Agassiz opposes those naturalists who, for distinction of the species, have especially attached themselves to the form of the head and to the arrangement of the colours, and says that the characters ought to be found in the structure of the head, in the opercular bones, in the surface of the cranium, and in its proportions relative to the whole body, and that the shape of the body also is important for the distinction of the species. When we add the size of the teeth and of the scales, characters as constant and excellent as any of those named, every one who peruses the descriptions terminating this paper will satisfy himself that our three British species have been distinguished from one another and from those of the Continent by those very characters which have been recommended by M. Agassiz. Ichthyology has been so much advanced within the last thirty years that it would be hardly fair to take the same view of a paper written in 1834 as if it were of a recent date; and I make these lengthened remarks only because there may still be some who, having adopted M. Agassiz's former views, will be inclined to adhere to them.

When M. Agassiz denounces the form of the *head* and the arrangement of the colours as too variable to supply precise characters, I can only partly agree with him. With regard to the former, it is only the *snout* which varies in its form according to age, sex, and season; but, according to my experience, this variation is subject to certain laws: if a male of a certain age has a hooked prominent lower jaw at a certain time of the year, all the males of that species, of the same age and at the same season, are provided with a hooked mandible; and this character may be well used as a specific distinction from another species without such a hook. Differences in the shade of colours are of no value for distinction of species. Sharply defined markings, as cross-bands, large spots, may be dependent on age, and peculiar to the young state of all the species of a whole group (dark cross-bands in the genus *Salmo* equivalent to the white streaks in the genus *Sus*, to the white spots in the genus *Cervus*, to the dark spots in the young Lion, to the light dots in *Muscicapa*, *Rubecula*, &c.); yet two species may differ, and really differ, in the development of those colours, and then they become a precise and valuable character, which is nearly always joined with another. By the colours alone, fresh specimens of *S. salvelinus* and *S. umbla*, of *S. grayi* and *S. willoughbii*, may be always distinguished.

Agassiz's view was adopted by Sir W. Jardine*, who, however, prefers to adopt another Linnean name, *S. alpinus*. He ascertained its occurrence in most of the lochs of the north-west of Sutherlandshire.

1835. Jenyns† adopts only a part of the view advocated by Agassiz, distinguishing a *S. umbla* and a *S. salvelinus*. With regard to the former it is not stated whence the specimens had been obtained which served as types for the description. "The elongated form, the gill-

* Report of the Fourth Meeting of the British Association, at Edinburgh, p. 614.
† Man. Hist. Vertebr. pp. 427, 428.

cover produced behind into a rounded lobe, the axillary scale nearly half as long as the ventrals, the fourteen dorsal rays," are characters which tend to show that a species was examined different from that of the Lake of Windermere, and closely approaching the Llanberris Torgoch, although I should not venture to identify it with the latter.

Mr. Jenyns describes his second species as the Torgoch, and calls it *S. salvelinus*. If unfortunately the specimens from which this second description was taken had been lost, everybody, like Parnell, would have been at a loss to reconcile it with any of the Charrs known. "The dorsal fin is exactly in the middle of the entire length; the body is not so much elongated in proportion to its depth; posterior portion of the dorsal very little less elevated than the anterior," &c. Such are the characters attributed to the Torgoch; but they are not in accordance with the typical specimens, which are still preserved and now in the British Museum. They, indeed, are identical with the Llanberris species, the proper characters of which may be found in the detailed description subjoined to this paper.

1838. If PARNELL's description* has been taken from a Scotch specimen, it is the only one which has been drawn up of the so-called Northern Charr; but much is detracted from its value when we consider that the author preserved his specimens as flat skins; therefore his statement, that the height of the body of a specimen $15\frac{1}{2}$ inches long was equal to the length of the head, and *one-sixth of the total*, does not express a peculiarity of the Northern Charr: but this elongate form of the body was probably caused by the way of preservation. Parnell's other observations on the Charr are borrowed from other authors, who had made their observations chiefly on English and Welsh specimens.

1840. The view of Agassiz was essentially supported by the late W. THOMPSON of Belfast, who, having had opportunity of examining the Charrs of Windermere, Loch Grannoch, Lough Melvin, and of nine other lakes in Scotland and Ireland, came to the conclusion that they are but one species—one, however, that is subject to extraordinary variety†.

But Mr. Thompson has not brought forward any other proof for this assertion, than the other assertion that the differences presented by the Charr from various localities are very manifold. The following appeared to him the most striking differences:—

1. In specimens from Loch Grannoch the male fish has the colours of *S. salvelinus*, Donov.; the female those of *S. alpinus*, Donov. The male has a much larger head and larger fins than the female. Number of ova, 500.

2. In specimens from Lough Melvin both sexes are coloured alike; nor can they be distinguished from each other by the size of the fins. Number of ova, 959.

The differences observed in the Charrs from the other localities are not pointed out. Certainly, if Mr. Thompson had really seen those in the size of the scales and of the teeth, he would have men-

* Fishes of the Firth of Forth, p. 148 (*S. umbla*).

† Ann. & Mag. Nat. Hist. 1840, vi. p. 439.

tioned them, and probably arrived at a different conclusion; but having found that some authors before him distinguished the species by the coloration as the chief character, and having satisfied himself that there is a great difference in this respect between the two sexes in the Loch-Grannoch fish, he did not make any further distinction between the other differences he was aware of, between accidental differences of individuals, between those of the two sexes, and, finally, between those of the fishes from various localities, but, considering all of them as equivalent, he was lost in a maze, out of which there was no other escape than to cut the Gordian knot by declaring those fishes as varieties of one and the same species.

We will not enter into a fruitless investigation as to the possibility of the differences which we observe in those fishes being induced by those physical peculiarities of the localities indicated by Mr. Thompson. We will take and examine them as they are, and as they will be, as long as zoologists of the present species of man exist, provided that human interference does not put a premature termination to the whole tribe. We find, then, that there are other constant differences in the Charrs from various localities, *besides* those of individuals, age, or sex—*which, derived from different parts, form an assemblage of characters affording easy specific distinctions**. If the difference were confined to a single character, to a slight modification of one organ only, I should not consider it sufficient to establish a separate species on it; if the difference consisted merely in the presence or absence of white margins of some of the fins, or if the fishes of one locality had only one fin-ray more, or one of the fins rather more elongate, than their representatives in another locality, one might call this a local variety. But if such a character is found always combined with a second, or with more, so that from the one an inference may be drawn as to the presence of the other, we are certainly obliged to make a specific distinction.

Thus, although we cannot agree with Mr. Thompson that the Windermere, the Welsh, and the Lough-Melvin Charrs are identical, we nevertheless consider his paper as highly important to our knowledge of the geographical distribution of the Charrs in Great Britain.

1. A Charr is found in Loch Grannoch, Kirkcudbrightshire, which makes its appearance only during ten days, never before about the 13th of October†. The sexes are distinct from each other

* Haller, in 'Correspondence of Linnæus;' ed. by Sir J. E. Smith, ii. p. 267.

† Objections have been made to my occasionally calling the Charr "in season during some of the winter months." The different species of Charrs appear to be "in season" at very different parts of the year—the freshwater Herring in November, the Torgoch towards the end of the year, the Charr of Windermere in May and August. Considering that those fishes are nearly secure from the persecutions of man during the rest of the year, they ought to be allowed to be taken when, once a year, they approach the shores in large shoals to spawn, at least in those localities where such a control might be kept over their capture that all danger of their becoming scarce would be avoided. Carnivorous fishes inhabiting a certain confined locality, like the Charrs, increase in number only to a certain degree; when their food becomes scarcer, they feed on their own progeny.

in colour, and in the size of the head and of the fins (in the number of the vertebræ, the male having 60, the female 62–63?); number of ova, 482. Beside a detailed description of the colours, the account does not contain anything from which we could determine the species.

2. Of other localities in Scotland, Loch Inch and Loch Corr are mentioned. They appear to be inhabited by a species identical with, or similar to, *S. willoughbii*; at all events by one very different from the "Haddy" of Loch Killin in Invernesshire. The latter is very interesting, inasmuch it appears to be closely allied to the Freshwater Herring of Lough Melvin. They are only caught when spawning, about the 26th of September.

3. The freshwater Herring of Lough Melvin appears to be confined to that locality.

4. Lough Dan (county Wicklow, Ireland) is inhabited by a Charr "presenting some of the characters both of the northern and Welsh Charr." Specimens were caught in summer with the fly.

5. Other localities in Ireland are—L. Kindun, L. Gartan, L. Derg, Lake of Luggela, Loughnabrak, and L. Corrib. The Charrs from those localities have a deep-red belly, and appear to approach *S. willoughbii* or *S. cambricus*.

6. The following localities in Ireland are named on the authority of other writers:—L. Esk (co. Donegal); Cummeloughs, in the mountains of Cummeragh; Lake of Inchigeelagh (co. Cork), and one or two other small lakes in this neighbourhood; L. Neagh*; a lake near Dunfanaghy (co. Donegal); L. Eaghish (co. Monaghan).

1841. Yarrell, in the first edition of his work, distinguished, according to the view of Donovan, a *S. umbla* and a *S. salvelinus*, adopting afterwards the opinion of Agassiz and Thompson. His account is composed of the observations of the different writers mentioned. As new localities, are mentioned Keswick, Crummock Water, Coniston Water, Loch of Moy, Loch Inch, &c. The Gilt Charr is mentioned as a variety of the Red Charr.

I conclude this paper with the descriptions of three species, which certainly are not the only ones by which Great Britain and Ireland are inhabited. I look forward with great hopes for the assistance kindly promised by various friends of natural history, trusting that with their help I shall finally be enabled to make up a complete series of specimens from all the localities which are inhabited by this obscure and therefore so interesting group of *Salmonidæ*, and to give a more satisfactory account of them after having compared them with their congeners of the Continent.

Salmo willoughbii. (Pl. V.)

(The Charr of Windermere.)

Body compressed, slightly elevated, its greatest depth being one-fourth of the distance of the snout from the end of the middle caudal rays; the length of the head is a little more than one-half of the distance of the snout and of the vertical from the origin of the dorsal.

* See pp. 41, 42.

Head compressed; interorbital space convex, its width being less than twice the diameter of the eye. Jaws of the male of equal length anteriorly; teeth of moderate strength, four in each intermaxillary, twenty in the maxillary. Length of the pectoral less than that of the head, much more than one-half of the distance between its root and that of the ventral. Dorsal rays twelve. 165 transverse series of scales above the lateral line. Sides with red dots; belly red; pectoral, ventral, and anal with white margins.

Description of a male specimen, length 11 *inches* 2 *lines.*—Head and body compressed, slightly elevated; its greatest depth is below the origin of the dorsal fin, where it is contained four times in the total length (to the end of the middle caudal rays). The least depth of the tail equals the length of the base of the dorsal fin. The height of the head above the mandibulary joint equals the distance between the posterior margin of the orbit and the end of the operculum. The upper profile of the head is somewhat elevated above the margin of the orbit, the diameter of which is nearly one-fifth of the length of the head, shorter than the snout, and more than one-half of the width of the interorbital space; the latter is very distinctly convex, with a rather prominent ridge along the middle, and with a pair of series of pores. Snout slightly compressed, subconical, with the jaws equal anteriorly. The *nostrils* are situated immediately before the eye; the posterior is the wider, and the cutaneous bridge between both is not developed in a flap. The *maxillary* extends scarcely beyond the vertical from the posterior margin of the eye, and is armed with 20–21 *teeth* of moderate size; four teeth in the intermaxillary, seventeen in each mandible, two pairs on the vomer, fifteen on each palatine bone, and four pairs on the tongue. The *suboperculum* forms the hindmost part of the gill-cover, and does not cover the exposed portion of the humerus above the root of the pectoral; its vertical width is rather less than one-half of that of the operculum, therefore it is comparatively narrow. Nearly all the *branchiostegals* are situated at the side of the head, and exposed in a lateral view of the fish. The lower branch of the outer *branchial arch* is provided with eleven lanceolate, slightly curved gill-rakers; the longest is less than two lines long in the specimen described.

D. 12. A. 12. P. 13–14. V. 9–10.

The origin of the dorsal fin is exactly in the middle between the snout and the root of the caudal; the length of its base is equal to the length of the last ray, and contained once and three-fourths in that of the fourth. The fourth and fifth rays form an acute point, and the upper margin of the fin is straight. The first ray is rudimentary, the second half as long as the third, the third three-fifths of the fourth, the fourth simple, the fifth branched, fourth and fifth longest, the last split to the base. The distance of the adipous fin from the dorsal is equal to twice and a third the base of the latter.

The origin of the anal fin is exactly in the middle between the root of the caudal and that of the outer ventral ray; the length of its base equals that of the dorsal, and is contained once and two-

thirds in the length of the fifth ray. The five anterior rays are enveloped in a common membrane, so that their length can be ascertained only by dissection; the fourth and fifth rays are the longest, and form an acute point; the lower margin of the fin is nearly straight. The first ray is rudimentary, the second half as long as the third, the third three-fourths of the fourth, the fourth simple, the fifth branched; the last split to the base, its length being two-fifths of that of the fourth.

Caudal fin forked, one of the middle rays being half as long as the outer ones, the length of which is contained five times and a half in the total. Lobes pointed.

The base of the pectoral is entirely free, and not overlapped by the gill-cover apparatus. It does not extend to the vertical from the origin of the dorsal, is rather shorter than the head, and at least two-thirds of the distance between its root and that of the ventral.

The ventral is inserted below the two last dorsal rays; its length being two-thirds of that of the pectoral, or of the distance between the root of its outer ray and the vent.

The scales are very thin and small; one taken from between the dorsal and the lateral line is ovate, two-thirds as high as long. In order to ascertain the number of transverse series of scales, it is necessary to count those above the lateral line, and not the perforated scales of the lateral line, which are larger than the others, and do not correspond to the transverse series. The scales on the back are minute, rudimentary, hidden in the skin.

The colour on the sides of the back is a dark sea-green, passing into blackish on the back, on the greater part of the dorsal and caudal. Sides with a slight silvery shade, passing into a beautiful deep red on the belly. Pectoral greenish, passing into reddish posteriorly, the upper margin being white; ventral red, with white outer margin, and with a blackish shade within the margin; anal reddish, with a blackish shade over the whole of the middle, and with white anterior margin; sides of the head silvery, lower parts minutely dotted with black.

The typical specimens were caught in the middle of November, during the time of spawning.

Through the kindness of F. T. Buckland, Esq., I have received four specimens of a closely allied species from Iceland. They are from 19 to 15 inches long, and were imported in large quantity by Mr. Hogarth: having been prepared like smoked Salmon, they are not in a state fit for an accurate examination, although in their external characters (even in the colours) they are pretty well preserved. The vertebral column, gills, and intestines had been removed from the fishes before they were smoked. Now those fishes agree *externally* very well with the Charr of Windermere; and I should not hesitate to consider them as one species, but for a statement made by Valenciennes, according to which the vertebral column of that northern species is composed of sixty-seven vertebræ*. Having laid bare the spine on one side of the Windermere specimen, which

* Cuv. et Val. xxi. p. 250.

I have described and figured, I have found only fifty-nine vertebræ —a number stated also by Yarrell. A difference of eight vertebræ will not be found within the limits of one species of *Salmo*; but it is a question whether the skeleton in the Paris Museum really is that of an Iceland Charr*, Valenciennes having comprised under the name of *Salmo alpinus* "plusieurs Truites rapportées de Norvège par Noël de la Morinière, ou de Suède et d'Islande par M. Gaimard," without adding whether the skeleton referred to belongs to a Scandinavian or Iceland specimen.

Faber ('Fische Islands,' p. 168) also mentions the Iceland Charr under the name of *Salmo alpinus*, a name which cannot be applied to the specimens brought by Mr. Hogarth, for the same reasons as stated above. The description given by him is valueless with regard to specific distinction; and as he unites a true (freshwater) Charr with another fish regularly entering the sea, it is probable that he has confounded two species.

SALMO CAMBRICUS (Pl. VI.).

(The Torgoch of Llanberris.)

Body slightly compressed and elongate, its greatest depth being one-fifth, or two-ninths, of the distance of the snout from the root of the caudal fin; the length of the head is considerably more than one-half of the distance of the snout and of the vertical from the origin of the dorsal. Head rather depressed, *interorbital space flat*, its width being less than twice the diameter of the eye. Male with the lower jaw longest; teeth of moderate strength,—six in each intermaxillary, twenty in each maxillary. Length of the pectoral less than that of the head, much more than one-half of the distance between its root and that of the ventral. Dorsal rays thirteen (fourteen). 170 transverse series of scales above the lateral line. Sides with numerous red dots, belly red; pectoral, ventral, and anal with white margins.

The numerous specimens examined of this species agree in every respect with one another. We take for the following description a *male specimen 9 inches long*, the usual size of the Torgoch, which scarcely ever exceeds the length of 12 inches.

Body rather compressed and elongate; its greatest depth is below the origin of the dorsal fin, where it is contained five times or four times and a third in the total length (without caudal). The least depth of the tail is three-fifths or two-thirds of the length of the base of the dorsal fin. The height of the head above the mandibulary joint equals the distance between the posterior margin of the orbit and the end of the operculum. The upper profile of the head is not elevated above the margin of the orbit, and is slightly concave. The diameter of the eye is one-fifth of the length of the head, two-thirds of the extent of the snout, and more than one-half of the width of the interorbital space; the latter is flat, with the median

* *Salmo umbla* (Lake of Constance) has sixty-five vertebræ (Rapp, Bodensee-Fische, p. 33).

ridge and the lateral series of pores scarcely visible. Snout rather depressed, conical, with the lower jaw slightly curved upwards and overreaching the upper. The *nostrils* are situated midway between eyeball and end of the snout; the anterior is round, open, surrounded by a membrane, which posteriorly is developed into a small flap, nearly entirely covering the smaller, oblong, posterior nostril. By this character alone the Torgoch may be distinguished from the Charr and Freshwater Herring. The maxillary extends to (or scarcely beyond) the vertical from the posterior margin of the eye, and is armed with 19–21 teeth of moderate size; six or seven teeth in each intermaxillary, seventeen in each mandible; seven teeth on the vomer form two sides of a triangle, the point of which is directed backwards; fifteen teeth on each palatine, five pairs on the tongue. The *suboperculum* is produced backwards, covering the triangular portion of the humerus above the root of the pectoral, and being in immediate contact with the latter; the vertical width of the suboperculum is one-half, or rather less than one-half, of that of the operculum. Only three *branchiostegals* are exposed in a lateral view of the fish, the others being situated at the lower side of the head. The lower branch of the outer *branchial arch* is provided with thirteen lanceolate straight gill-rakers; the longest is somewhat less than two lines long in the specimen described.

D. 13 (14). A. 12 (11). P. 12 (13). V. 9.

The origin of the dorsal fin is somewhat nearer to the snout than to the root of the caudal; the length of its base is not much less than its height. The fifth and sixth rays form the rounded top of the fin. The first ray is rudimentary, the second half as long as the third, the third half as long as the fourth, the fourth simple, five-sixths of the fifth, which is branched, the sixth the longest, the last split to the base. The length of the base of the dorsal is contained once and a third in its distance from the adipous fin.

The origin of the anal fin is exactly in the middle between the root of the caudal and that of the outer ventral ray; the length of its base is less than that of the dorsal, and not much less than its height. The four anterior rays are enveloped in a common membrane; the fourth and fifth rays form a rounded point; and the lower edge of the fin is slightly emarginate. The first ray is short, the second half as long as the third, the third three-fourths of the fourth, the fourth simple, a little shorter than the fifth, which is the longest and branched; the last split to the base, its length being nearly one-half of that of the fifth.

Caudal fin emarginate, the length of a middle ray being a little more than one-half of that of the outer ones, the length of which is contained six times and a half in the total. Lobes slightly rounded.

The base of the pectoral is overlapped by the gill-cover apparatus. It extends nearly to the vertical from the origin of the dorsal, is considerably shorter than the head, and three-fourths of the distance between its root and that of the ventral.

The ventral is inserted in the vertical from the eighth to eleventh

dorsal rays, its length being two-thirds of that of the pectoral, or of the distance between the root of its outer ray and the vent.

The scales are very thin and small, deeply imbedded in the skin; one taken from between the dorsal and the lateral line is ovate, two-thirds as high as long. The perforated scales of the lateral line do not correspond to the transverse series. Scales on the back minute.

The back is dark sea-green, which colour becomes lighter on the sides, assuming a yellowish shade and gradually passing into the bright red of the lower parts; sides with numerous reddish orange-coloured dots. Pectoral greenish, passing into reddish posteriorly, the upper margin being white; ventral and anal red, with white anterior margins; dorsal and caudal blackish, with broad lighter margins. Cheeks and suboperculum with numerous black dots.

Vertebræ: sixty-one.

Young specimens, from 5 to 6 inches long, scarcely differ from the adult specimens described. They are from Mr. Yarrell's collection, who obtained them from a lake near Barmouth in Merionethshire, called Coss-y-gedawl. In consequence of the young age the eye is much larger, longer than the snout, two-sevenths of the length of the head, the maxillary not extending to the posterior margin of the orbit. The pectorals are comparatively a little shorter, the ventrals a little longer, than in the adult. Dorsal fin with fourteen rays —that is, two rays more than in the Charr. The dark colour of the back emits eight cross-bars on the sides, and the red dots are larger and less in number—differences such as are usually observed between old and young *Salmonidæ*. The specific characters (the flat head, elongate body, rounded fins, peculiar nostrils, increased number of dorsal rays, &c.) are very conspicuous. Yarrell has given a figure of one of the specimens, in which the head is incorrect in nearly every respect.

The typical specimens were caught on the 26th and 29th of November; the time of spawning appeared to have been then beginning.

Salmo gravi (Pl. VII.).

(The Freshwater Herring of Lough Melvin.)

Body compressed, slightly elevated, its greatest depth being one-fourth of the distance of the snout from the end of the middle caudal rays; the length of the head is scarcely more than one-half of the distance of the snout and of the vertical from the origin of the dorsal. Head compressed; interorbital space convex, its width being less than twice the diameter of the eye. Jaws of the male of equal length anteriorly; *teeth very small*, four in each intermaxillary, sixteen in the maxillary. Length of the pectoral equal to, or rather more than, that of the head, terminating at no great distance from the ventral. Dorsal rays thirteen or fourteen. 125 transverse series of scales above the lateral line. Sides with scattered light orange-coloured dots; belly uniform silvery whitish, or with a light-reddish shade; fins blackish.

Description of a male specimen, length 10½ *inches.*—Head and body compressed, slightly elevated, its greatest depth being below the origin of the dorsal fin, where it is contained four times in the total length (to the end of the middle caudal rays). The least depth of the tail is considerably less than the length of the base of the dorsal fin. The height of the head above the mandibulary joint is more than the distance between the posterior margin of the orbit and the end of the operculum. The upper profile of the head is elevated above the margin of the orbit, the diameter of which is one-fifth of the length of the head, shorter than the snout, and a little more than one-half of the width of the interorbital space. The latter is convex, with a prominent ridge along the middle, and with a pair of series of pores. Snout slightly compressed, subconical, with the jaws equal anteriorly. The nostrils are situated midway between the end of the snout and the anterior margin of the eyeball; the posterior is the wider and round, the anterior being a very narrow vertical slit; both are separated by a narrow cutaneous bridge. The *maxillary* extends to the vertical from the posterior margin of the eye, and is armed with sixteen very small *teeth*, the posterior ones being quite rudimentary. All the other teeth small—four in the intermaxillary, twelve in each mandible, two to four on the vomer, fifteen on each palatine, and four pairs on the tongue. The *suboperculum* forms the hindmost part of the gill-cover, and does not cover the exposed portion of the humerus above the root of the pectoral; it is narrow, its vertical width being one-third of that of the operculum. Only the two or three outer *branchiostegals* are exposed in a lateral view of the fish, the others being situated at the lower side of the head. The lower branch of the outer *branchial arch* is provided with nine lanceolate straight gill-rakers; the longest is two lines long in the specimen described.

D. 13 (14). A. 12. P. 13-14. V. 9.

The origin of the dorsal fin is nearer to the end of the snout than to the root of the caudal; the length of its base is considerably more than that of the last ray, and contained once and two-fifths in that of the fourth ray. The fourth and fifth rays form an acute point, and the upper margin of the fin is nearly straight. The first ray is nearly half as long as the second, the second half as long as the third, the third not much shorter than the fourth; the fourth and fifth are longest, the former simple and the latter branched; the last is split to the base, and nearly half as long as the fifth. The distance of the adipous fin from the dorsal is less than twice the length of the base of the latter.

The origin of the anal fin is in the middle between the root of the caudal and that of the outer ventral ray; the length of its base is less than that of the dorsal, and two-thirds of the length of the fifth ray. The fourth, fifth, and sixth rays are the longest, and form an acute point; the lower margin of the fin is slightly emarginate. The first ray is short, half as long as the second; the second half as long as the third; the third two-thirds as long as the fourth, which s

simple; the fifth branched; the last is split to the base, two-fifths as long as the fourth.

Caudal fin forked, one of the middle rays not being quite half as long as the outer ones, the length of which is one-fifth of the total. Lobes pointed.

The base of the pectoral is entirely free, and not overlapped by the gill-cover apparatus. It is as long as, or even longer than, the head, and extends to, or slightly beyond, the vertical from the origin of the dorsal, terminating at a short distance from the ventral.

The ventral is inserted below the ninth, tenth, and eleventh dorsal rays, its length being three-quarters of that of the pectoral; it terminates at no great distance from the vent. In smaller specimens than the one described the two outer rays are somewhat less lengthened.

The scales are very conspicuous, comparatively much larger than in the other British species. Those between the dorsal fin and lateral line are nearly square, with the hind margin rounded. Those of the lateral line are not larger than the others; and their number, therefore, nearly coincides with the number of the transverse series. The scales on the back are the smallest, yet very distinct.

Sides and belly silvery; the scales on the side of the back have a silvery centre and a blackish margin; the back itself bluish black; belly with a reddish shade; sides with scattered light orange-coloured dots; fins blackish; the dorsal lighter superiorly, and with a few light dots at the base; ventral with a narrow whitish margin. Head silvery, black above.

This account of the "Freshwater Herring" is very incomplete, and can be considered only as the first step towards a satisfactory knowledge of this species. We are not yet acquainted with the immature state, or with variations which may occur, and with the female fish only by a short notice of Mr. W. Thompson. I have before me two other male specimens of nearly the same size as the one described, but without any indication of the locality, and preserved in spirits for a long time; and six other specimens given to Prof. W. Thomson, of Belfast, as being perhaps from Lough Melvin, and kindly lent to me for examination. Those eight specimens agree with the Freshwater Herring in the small size of their teeth, by which character these Irish fishes may be at once distinguished from the other allied European species—in the shortness of their head, in the length of their pectoral, and in the shape of the fins; but they differ from the typical specimens in several not unimportant points, which I shall point out when a further supply of specimens shall enable me to form a definite opinion about the value of those differences. I may, however, mention that the females of one of those Irish fishes have fully developed eggs of the size of a pea, when only 5 inches long! Without full material, and with the uncertainty as to locality, it would be as dangerous to establish new species on differences which may, after all, turn out to be dependent on age, as unwise to refer them to the "Freshwater Herring" of Lough Melvin, thereby destroying a definition of its specific characters.

The typical specimens were taken in the beginning of November,

evidently with a net; the state of their sexual organs shows that the spawning commences at that time of the year. It must be very difficult to catch the fishes after the middle of November, partly because they retire into the deeper parts of the lake, and partly because the attempts to set nets are frustrated by the stormy weather of the season. Repeated endeavours to obtain more specimens, made by the Earl of Enniskillen, proved to be unsuccessful. In a letter from Mr. J. Walker, this gentleman mentions that he saw one taken with a fly in the month of August.

The Earl of Enniskillen mentions, in a letter directed to Mr. Thompson, that the "Freshwater Herring" is plentiful in the middle of November. "The people are now taking them in cartloads. The flesh of such as I send is white and soft, and different from what that of Charr is in any other lough." Mr. Thompson* saw the female; and, according to him, it is externally not different from the male. The ovaria contained 959 ova in a specimen 11 inches in length, each being two lines in diameter.

Number of vertebræ sixty, as ascertained by Thompson in a male and female fish, and by myself in two males.

7. Review of the Vermetidæ. By Otto A. L. Mörch (of Copenhagen). (Part III.)

[Concluded from Proc. Zool. Soc. 1861, p. 365.]

Bivonia, Gray, 1850.

The *Bivinæ*, Gray, Cat. Brit. Mus. 1842, p. 62.

Bivonia, Gray, *ibid.* p. 90; Gray, 1850, in Mrs. Gray's Fig. iv. p. 82. no. 3; Adams, Genera, i. p. 358.

T. affixa, plerumque spiralis, apertura contracta circulari, sæpe liris spiralibus interupto-nodulosis et lira mediana elevata; columella lævissima, nitida.

Animal tentaculis cylindricis, filamentis pedalibus subulatis vel setaceis. Operculum parvum, rudimentare (Phil.).

Dr. Gray gives (in the Brit. Mus. Cat. 1842, p. 62) the following character:—"The *Bivinæ* have an orbicular spiral operculum, with an oblong lateral scar like the *Trochi*." I suppose this description was made from a broken specimen, giving the muscular impression the appearance of being lateral. In the Brit. Mus. Cat. for 1840, quoted in Proc. Zool. Soc. no. 258, by Dr. Gray, I cannot find anything about this genus. The edition 1844, quoted in the same place, is, according to the indication of the pages 62 & 90, no doubt a typographical error. In the Systematic Index of Mrs. Gray's Fig. of Mollusca, p. 82, the diagnosis is altered thus:—"Operculum rudimentary, small (spiral?)," which is evidently taken from Philippi's description of *Vermetus triqueter*, Biv.,—"Operculum parvum, rudimentare," which must thus be regarded as the type. Of the other

* Ann. and Mag. Nat. Hist. 1841, vi. p. 443.